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REPORT ON CALORIMETRIC INVESTIGATIONS OF GAS-PHASE CATALYZED HYDRINO FORMATION

Submitted by
Prof. Jonathan Phillips* ,
and Julian Smith
Department of Chemical Engineering
Penn State University
University Park, PA 16802

Ph: (814) 863-4809
Fax: (814) 865-7846

Professor Stewart Kurtz
Department of Electrical Engineering
Penn State University
University Park, PA 16802

Ph: (814) 863-8407
Fax: (814) 863-8561

Jonathan Phillips

Julian Smith

Stewart Kurtz

*Corresponding Author

SUMMARY

Tests for heat production associated with hydrino formation were carried out with two types of calorimeters during the period October-December 1996. Experiments carried out in a modified Calvet system yielded extremely exciting results. Specifically, initial results are apparently completely consistent with the Mill's Hydrino formation hypothesis. In three separate trials between 10 and 20 K Joules were generated at a rate of 0.5 Watts, upon the admission of approximately 10^{-3} moles of hydrogen to the 20 cm ^{3} Calvet cell containing a heated platinum filament and KNO_3 powder. This is equivalent to the generation of $1*10^7$ J/mole of hydrogen, as compared to $2.5 *10^5$ J/mole of hydrogen anticipated from standard hydrogen combustion. Thus, the total heats generated appear to be two orders of magnitude too large to be explained by conventional chemistry, but the results are completely consistent with the Mill's model. It must be noted that although the results presented in this report are very exciting , they require further verification. Moreover, it should be noted that some control studies are not yet complete.

Also included is a brief report on an attempt to replicate the Calvet cell results on a larger scale using the water bath calorimeter (described in some detail in an earlier report). Unfortunately, no evidence of 'excess heat production' was found. This can be linked to a failure to maintain the catalyst ions ($K+$) in the vapor phase. Specifically, it is hypothesized that the KNO_3 catalyst evaporated from the containing pot at the reactor center, where the temperature is high, and deposited on the reactor walls, which are cold due to immediate contact with the calorimeter water bath. (That is, the catalytic material is 'cryo-pumped' by the cold walls.) Indeed, at the conclusion of the experiment, when the reactor was removed from the water bath, the walls of the quartz reactor were observed to be white in the general vicinity of the pot which contained the KNO_3.

INTRODUCTION

Experiments were conducted to test the hypothesis that in the gas phase potassium ions will catalyze the conversion of hydrogen atoms to hydrino atoms. These experiments were initially carried out in a Calvet cell as this type of calorimeter is highly sensitive and accurate. Moreover, the conditions of the calorimeter are controlled.

RM's theory of hydrino formation requires that both K+ ions and H-atoms are present in the gas phase. In order to generate gaseous K+ ions, KNO_3 is placed in a small (2cc) quartz 'boat' inside the calorimeter cell. The boat is heated, to increase the vapor concentration of KNO_3, with a platinum filament, which is wound around the boat. A second function of the platinum filament is to generate H-atoms. It is well known that hydrogen molecules in contact with a heated filament will decompose, yielding a relatively high H-atom concentration in the boundary layer around the filament. Thus, according to RM's model, in a cell containing KNO_3 in the boat and vapor phase hydrogen, there is a small region in the boundary layer around the heated metal filament which should contain sufficient concentrations of both H-atoms and K+ ions for hydrino formation to occur.

Calorimetric considerations require that a stable baseline exists before the heat generating process is initiated. Thus, signal change away from the baseline can be correlated to the onset of the process under investigation. In the present experiments the cell was run with KNO_3 in the boat and the filament fully 'powered'. The calorimeter was allowed to equilibrate until a steady baseline existed. The 'hydrino formation' process was initiated by then adding gaseous hydrogen. Good calorimetric practice also requires that adequate control studies be carried out. Also required are repeated electric calibrations.

In the present work, data is presented which indicates that significant heat evolved upon the introduction of hydrogen to the Calvet calorimeter cell. In contrast, no heat was evolved upon the admission of helium. Repeated calibrations were also conducted. Thus, it appears that The RM

hypothesis is supported by the present results. A more definitive statement must await repeats of these experiments, and the results of a few additional control experiments.

An attempt was also made to employ the water bath calorimeter (see previous report to HPC) to detect excess heat. Indeed, the positive results of the Calvet study present a staggering challenge to conventional physics. Challenges of this magnitude require enormous experimental support. Thus, evidence of excess heat production from a second type of calorimeter would be useful. Unfortunately, the experiment failed to yield any evidence of excess heat. However; there is reason to believe that catalyst concentration was low and thus the failure to observe excess heat does not disprove the Mill's hypothesis.

EXPERIMENTAL SYSTEM

Calvet Calorimeter. The Calvet-type calorimeter employed in this study is similar to one described in the literature (attached) and is also described in earlier reports to HPC (now BLP). In essence a stainless steel cup of almost exactly 20 cm^3 volume is placed in a calorimeter well such that the cup is surrounded by thermopiles on its sides and bottom. The cup and calorimeter are surrounded by a thick layer of insulation, and the entire device is placed inside a commercial convection oven. In all cases experiments were conducted with the oven temperature set to 250 C.

Reaction cell. For these experiments the top of the calorimeter cup/reactor cell was fitted with a Conflat knife edge flange. The top element of the flange is connected to a gas supply system outside the convection oven with a 0.5 cm OD ss tube, and with two welded vacuum high current copper feedthroughs. The feedthroughs were connected on the cup side of the flange to a coiled section of 0.25 mm platinum wire approximately 18 cm in length. Fitted inside the coiled platinum was a small quartz boat into which 200 mg of powdered KNO_3 were placed.

Plumbing. On the outside of the oven the gas feed through is connected to a line leading to hydrogen and helium tanks, a pressure gauge, and a standard vacuum roughing pump. It is notable that the gas lines were all well insulated, both inside the oven, and for about 50 cm outside the oven.

The plumbing system was so arranged that the cell could be evacuated, and then isolated from the pump in such a way that hydrogen or helium could be added directly from high-purity gas tanks. Great care was taken before the experiments were initiated to evacuate and flush the gas lines several times. It was also determined that the lines held gas pressure, with no loss in pressure, for several days. That is, there were no leaks.

Water Bath Calorimeter. This instrument is described in detail in the previous report to HPC. Two minor modifications were made for the present experiment. First, to facilitate the decomposition of hydrogen, the center section of the mandrel was wrapped with a 60 cm length (about 8 cm of mandrel) of 0.25 mm diameter platinum wire. Second, in the center of this section the same quartz boat (again filled with about 200 mg of catalyst) used in the Calvet system, wrapped with the same coil of platinum wire, was inserted into the circuit. (The experiment described was carried out after the completion of the Calvet system experiments.)

RESULTS

Calvet Calorimeter. The Calvet studies suggest large amounts of heat are generated upon the admission of hydrogen to the cell. In contrast, virtually no heat is observed upon admission of helium to the cell.

Calibration. The first tests performed on the Calvet system were electrical calibration experiments. The system was set-up for full experimentation: KNO_3 was in the boat, the system was evacuated, and 10 watts of steady power were supplied to the platinum coil. After a steady baseline was achieved (approximately 10 hours after the oven was adjusted to 250 C), the cell was isolated from the pump and the pressure allowed to equilibrate (approximately 100 Torr). This did not appear to impact the baseline in any fashion. The power supply was then adjusted to deliver an additional 1 watt (11 watt rather than 10) for a specified time period. The power was then returned to the original 10 watt setting. A typical response curve is shown in Figure 1. The area under the response curve can be used to obtain a calibration constant which relates signal area increase to the number of extra Joules delivered. This was done in four cases (Table I). As can be seen, there is some error (+/- 15%) in the calculated calibration constant.

Control Studies. Helium was admitted, approximately 10 psig, to the cell to test the impact of a change in pressure, and heat transfer characteristics on the response of the cell. The helium was admitted after the cell had been isolated from the pump for a considerable time and a steady pressure (approximately 100 Torr) achieved. As can be seen in Figure 2a, the response was a short-lived small increase in output signal, followed by a relatively short time period during which the signal gradually returns to the original baseline. Within an hour the signal returned to the original baseline, with some drift evident.

The response of the system is expected. The helium increases the rate of heat transfer away from the platinum filament, and heated boat. Thus, the initial addition of helium to the system results in a temporary increase in the amount of heat reaching the thermopiles. That is, the boat and the filament cool off, until such time as the boat and filament have reached their new steady state temperatures. The steady state temperature of boat and filament are a function of heat transfer mechanism. After the admission of helium most heat transfer is occurring by convection to the walls. Before the admission of helium a considerable fraction is by radiation. Radiative transfer of 10 watts requires a higher filament/boat temperature than does convective heat transfer.

Figure 2b illustrates again the impact of adding pressure, or removing gas, from the system. Upon the addition of helium there is a very short lived increase in heat reaching the thermopiles. Upon pumping there is a period of time, perhaps an hour, during which the heat signal goes below the baseline. This is consistent with the model in that pumping makes convective and diffusive heat transfer minimal. Virtually all heat transfer is by radiation, which requires that the filament/boat temperature increase. It takes some time for this new steady-state temperature to be reached.

Hydrogen Admission. Hydrogen admission was carried out in much the same fashion as helium admission. The cell reached an equilibrium pressure, approximately 100 Torr, and then hydrogen at 10 psig was admitted to the cell. The valve to the hydrogen source, which was a steel line 4 meters by 0.6 cm OD, was closed off by a valve in front of the regulator during admission. Moreover, it was open for only a couple of seconds in each case. This was done on three separate

occasions, and the signal that evolved in response to these three processes is recorded in Figures 3, 4 and 5. One other observation recorded was that the pressure decreased gradually over time, such that after about an hour the pressure returned to the original equilibrium pressure of the cell. It must also be noted that the heat production was ended deliberately in all three cases by pumping the system to $5*10^{-3}$ Torr. It is clear 'excess heat' evolution would have continued in all cases if the system had not been evacuated.

It is expected that in the absence of reaction that the response of the cell to the addition of hydrogen would be similar to that observed for helium. Indeed, given that pressure measurements suggest that most hydrogen is adsorbed, or in some other fashion removed from the cell after an hour, even heat transfer effects should be totally transitory. Even in the event of reaction no more than a small heat signal is expected. Indeed, a high end estimate is that 25 cm^3 of hydrogen at a temperature of 300 K and a pressure of 2 atmospheres entered the cell. This is equivalent to $2*10^{-3}$ moles of hydrogen. If all of that hydrogen interacted with oxygen to form water only 510 J would be generated. It is possible to imagine that the hydrogen could interact with nitrogen in KNO_3 to form ammonia. Even less energy would evolve from this process. Thus, the largest heat peak might be expected to be 0.5 watts for 1000 seconds (approx. 17 minutes). A block of this size is marked on Figure 3.

It is clear from figures 3, 4 and 5 that hydrogen admission to the cell apparently leads to far more energy evolution than can be explained by any conventional chemical process. It is interesting in this regard to graphically contrast the response of the system to helium admission to the response to that for hydrogen admission. This is done on Figure 6 in which Figure 3 and Figure 2a are superimposed.

<u>Water Bath Calorimeter.</u> Studies conducted with the water bath calorimeter do not indicate the evolution of any excess heat. As shown in Figure 7 the increase in temperature almost exactly parallels the increase predicted on the basis of the amount of energy added to the system and the known heat capacity of water.

Do the results of the experiment refute the RM hypothesis? No. At the conclusion of the experiment the large cell was removed from the water bath and a white coating was seen on the walls in the vicinity of the pot which contained the KNO_3. This suggests that the KNO_3 was rapidly cryopumped by the walls, and that the gas phase concentration of catalyst was too low to be effective.

DISCUSSION

The evidence presented in this report clearly suggests that an extraordinary phenomenon takes place upon the admission of hydrogen to a cell containing a heated platinum filament and KNO_3. This phenomenon appears to generate a tremendous amount of 'excess' heat. Still, the author of this report urges that a cautious approach be taken at present. Additional experimental work is required. A partial list of proposed additional experiments is given below:

1) A control experiment consisting of admission of hydrogen to a cell in which 10 watts of power is applied to a platinum filament, but no KNO_3 is present.

2) Hydrogen is admitted to a cell containing a platinum filament and KNO_3 in a boat, but no power is applied to the filament.

3) The experiments are run as described in the present report, but the boat containing KNO_3 is at the bottom of the cell, rather than in the center of the platinum coil.

4) The hydrogen admission experiments described above are repeated BUT continued for times sufficient to return the signal to the original baseline.

In addition, modifications in the apparatus should be made. First, insulation should be added to improve the stability of the baseline. Second, a quality pressure gauge should be attached to a known volume outside the oven such that all uncertainty regarding the number of moles of hydrogen admitted to the cell can be eliminated. Third, the plumbing should be re-arranged to facilitate 'capture' of gas for analysis using gas chromatography. Fourth, provision should be made to permit pressure to be recorded as a function of time.

Typical Calibration Experiment: 1 W Input, 20 Mins

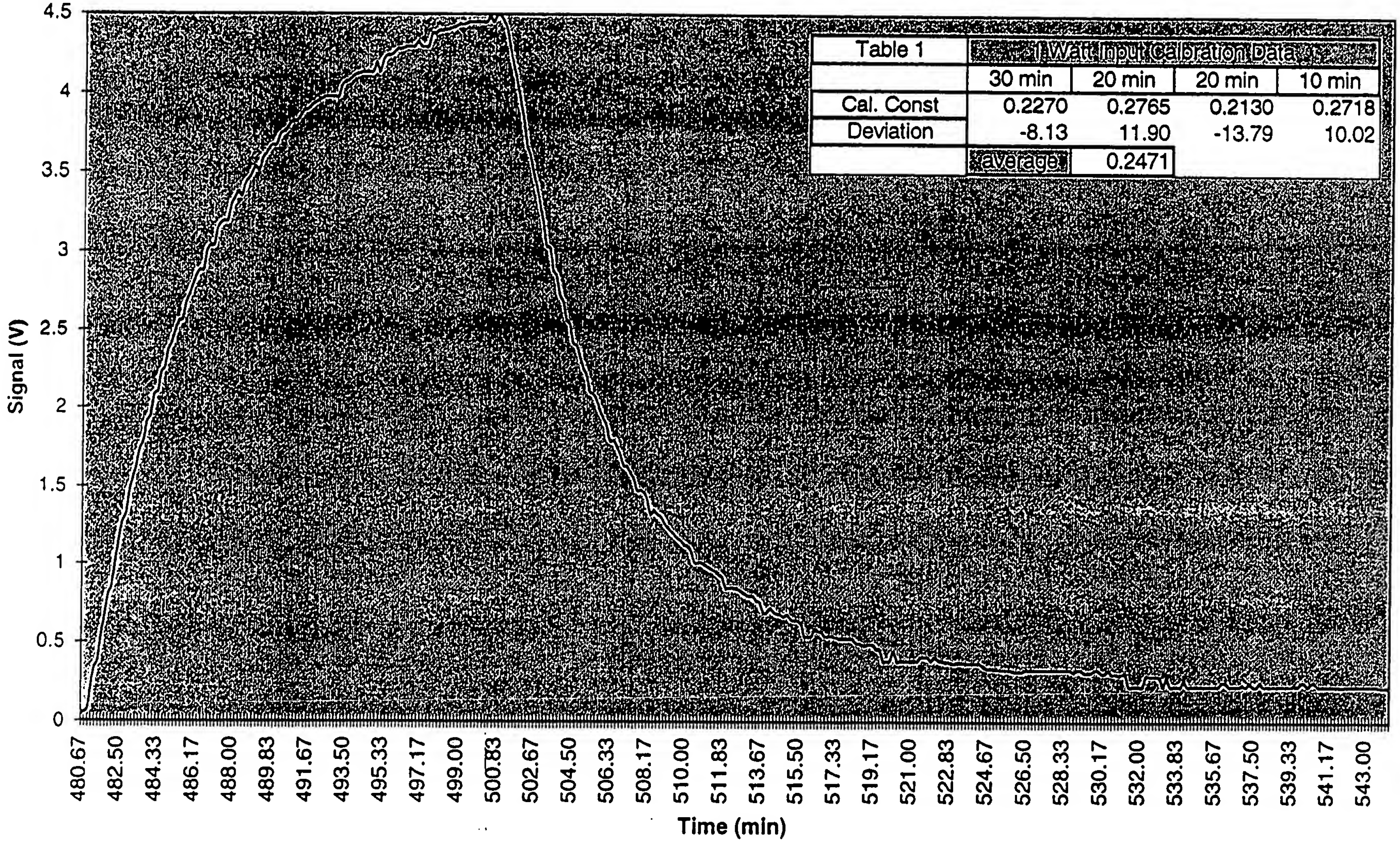


Table 1	1 Watt Input Calibration Data			
	30 min	20 min	20 min	10 min
Cal. Const	0.2270	0.2765	0.2130	0.2718
Deviation	-8.13	11.90	-13.79	10.02
	average	0.2471		

Figure 1

Heat Production, KNO3 w/ Helium Injection (BL1220A)

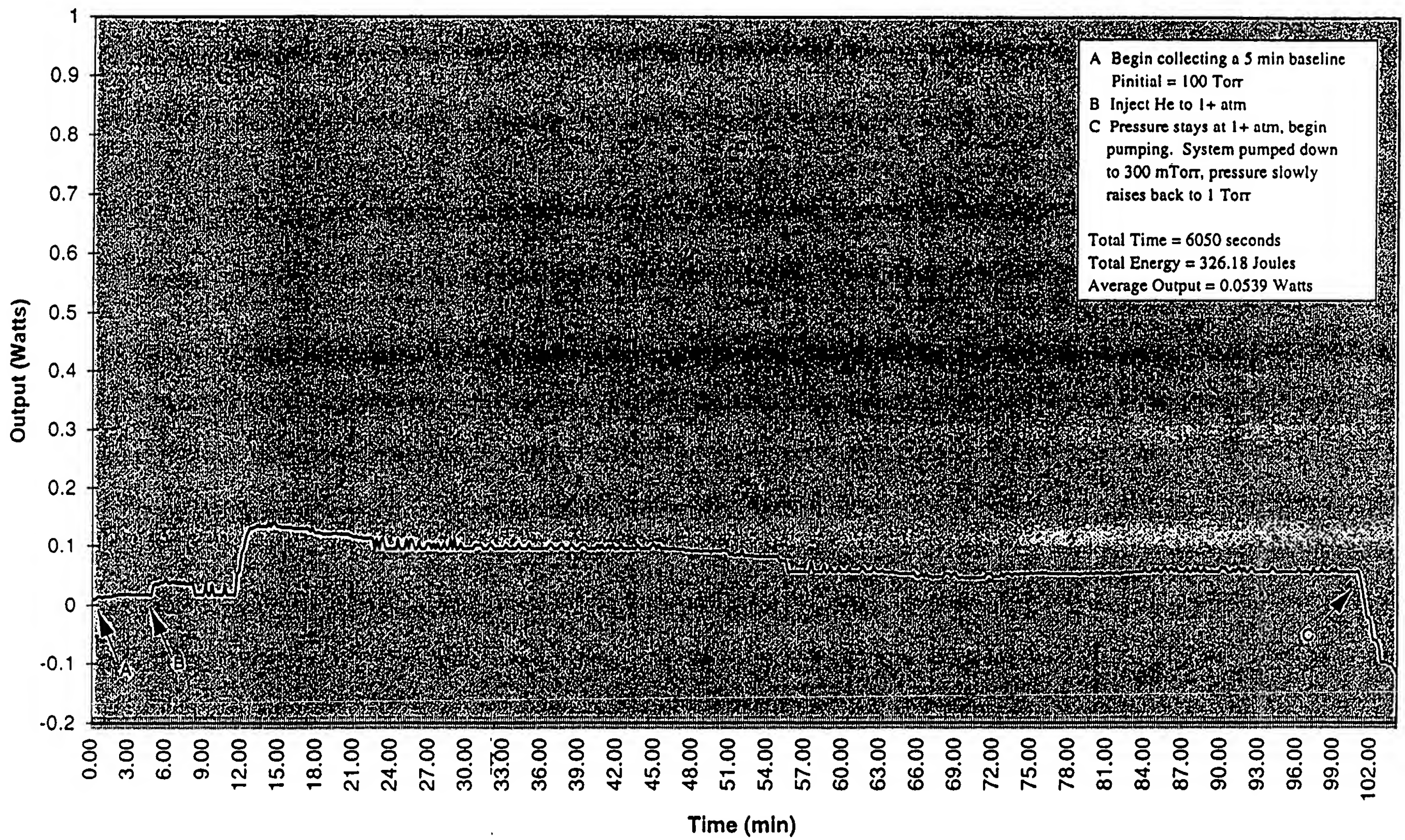


Figure 2A

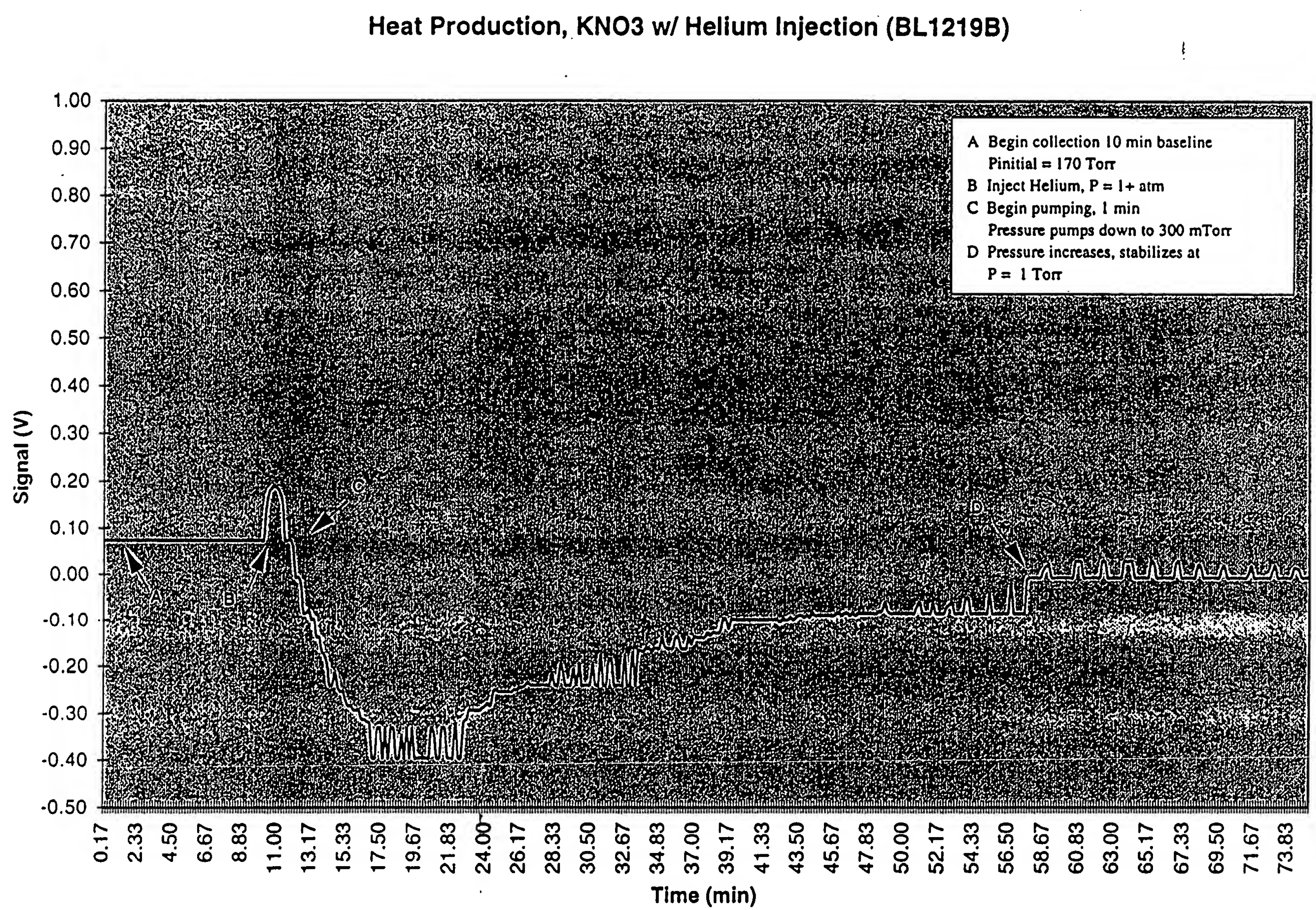
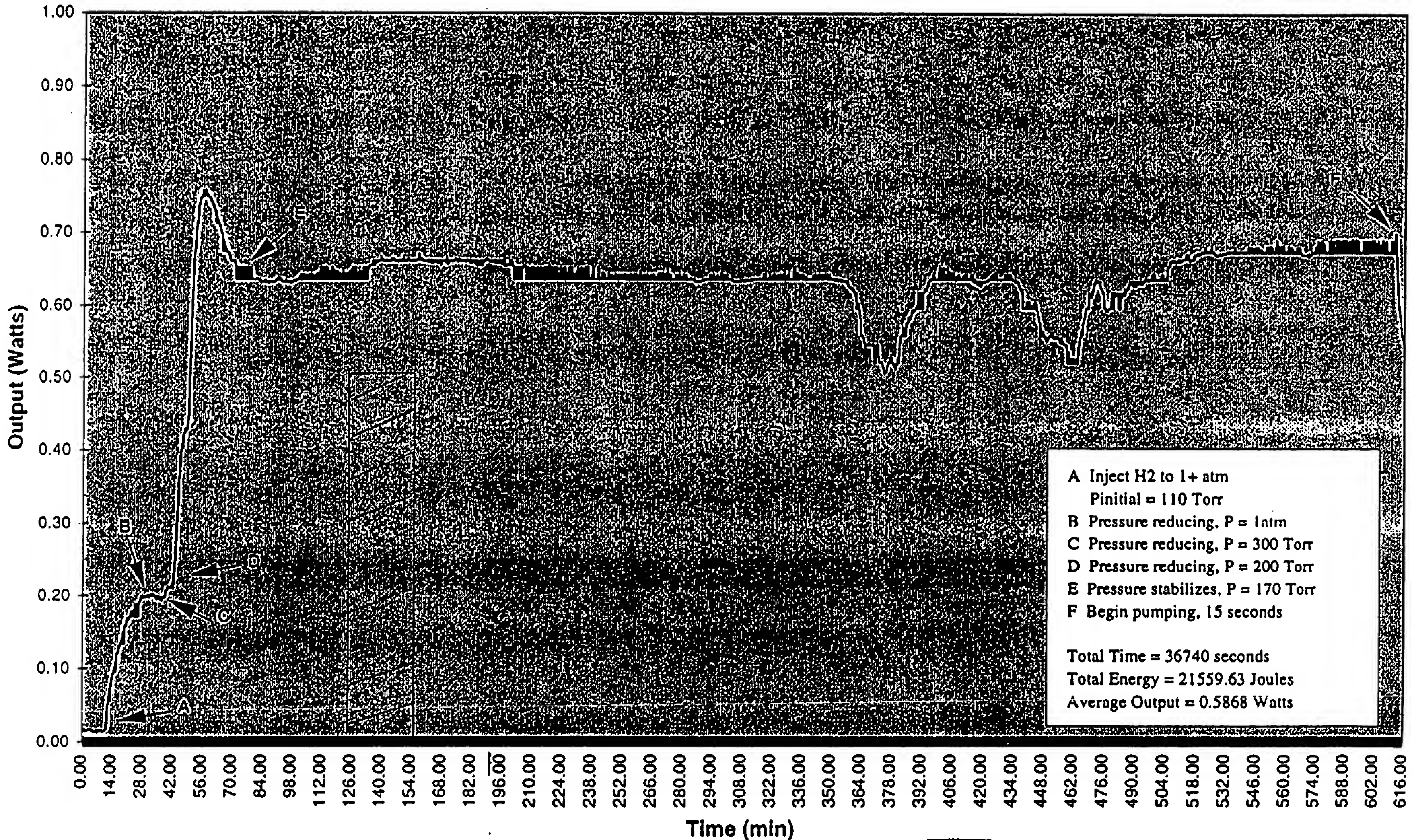

Heat Production, KNO3 w/ Helium Injection (BL1219B)
Signal (V)
Time (min)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0.17
2.33
4.50
6.67
8.83
11.00
13.17
15.33
17.50
19.67
21.83
24.00
26.17
28.33
30.50
32.67
34.83
37.00
39.17
41.33
43.50
45.67
47.83
50.00
52.17
54.33
56.50
58.67
60.83
63.00
65.17
67.33
69.50
71.67
73.83
A Begin collection 10 min baseline
Pinitial = 170 Torr
B Inject Helium, P = 1+ atm
C Begin pumping, 1 min
Pressure pumps down to 300 mTorr
D Pressure increases, stabilizes at
P = 1 Torr
A
B
C
D

Figure 2B

Heat Production, KNO3 w/ H2 Injection (BL1218CD)



– Peak area expected if all admitted H_2 reacts with O_2 to form H_2O.

Figure 3

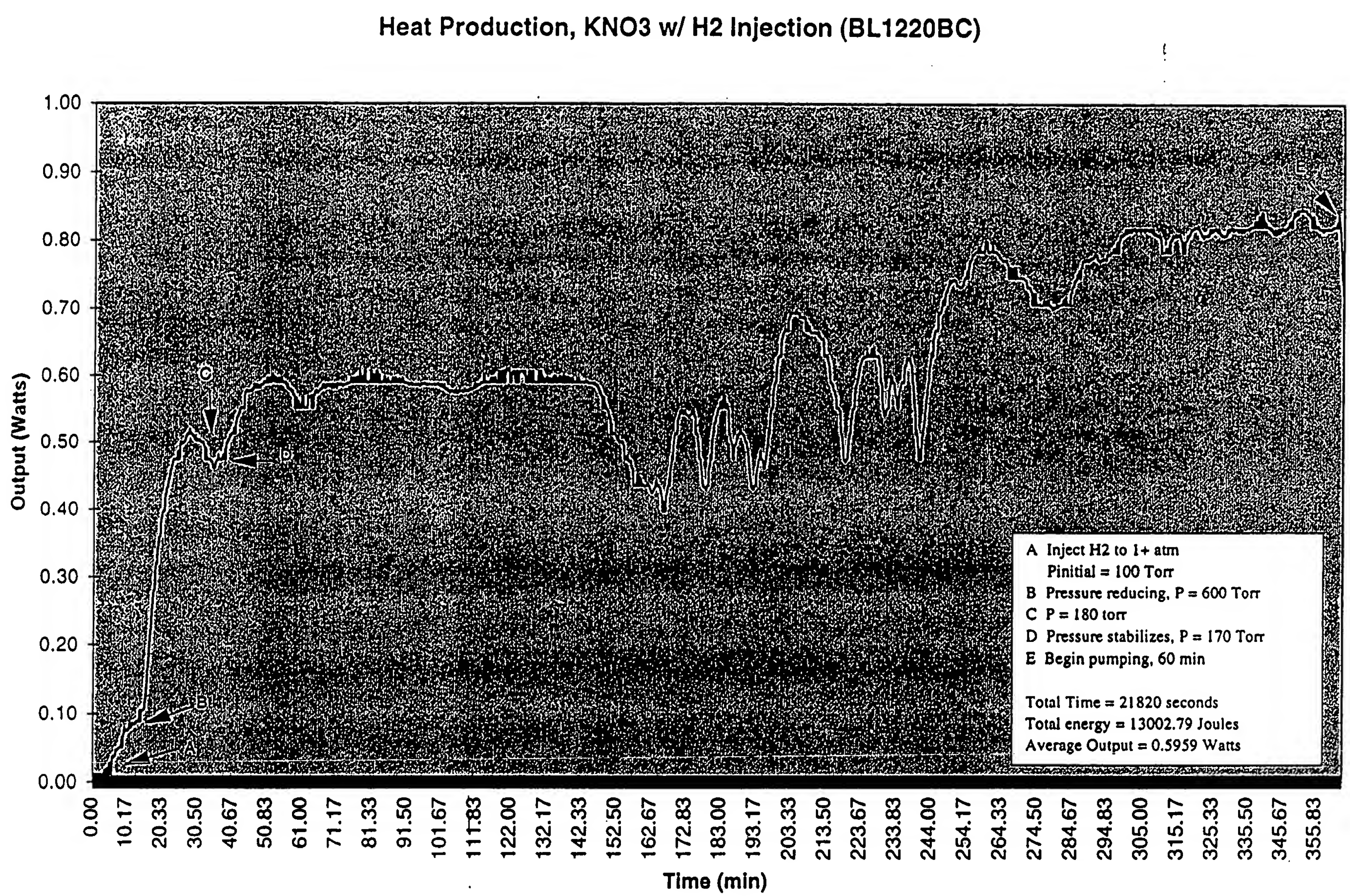

Heat Production, KNO3 w/ H2 Injection (BL1220BC)
Output (Watts)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
10.17
20.33
30.50
40.67
50.83
61.00
71.17
81.33
91.50
101.67
111.83
122.00
132.17
142.33
152.50
162.67
172.83
183.00
193.17
203.33
213.50
223.67
233.83
244.00
254.17
264.33
274.50
284.67
294.83
305.00
315.17
325.33
335.50
345.67
355.83
Time (min)
A
B
C
D
E
A Inject H2 to 1+ atm
Pinitial = 100 Torr
B Pressure reducing, P = 600 Torr
C P = 180 torr
D Pressure stabilizes, P = 170 Torr
E Begin pumping, 60 min
Total Time = 21820 seconds
Total energy = 13002.79 Joules
Average Output = 0.5959 Watts

Figure 4

Heat Production, KNO3 w/ H2 Injection (BL1221AB)

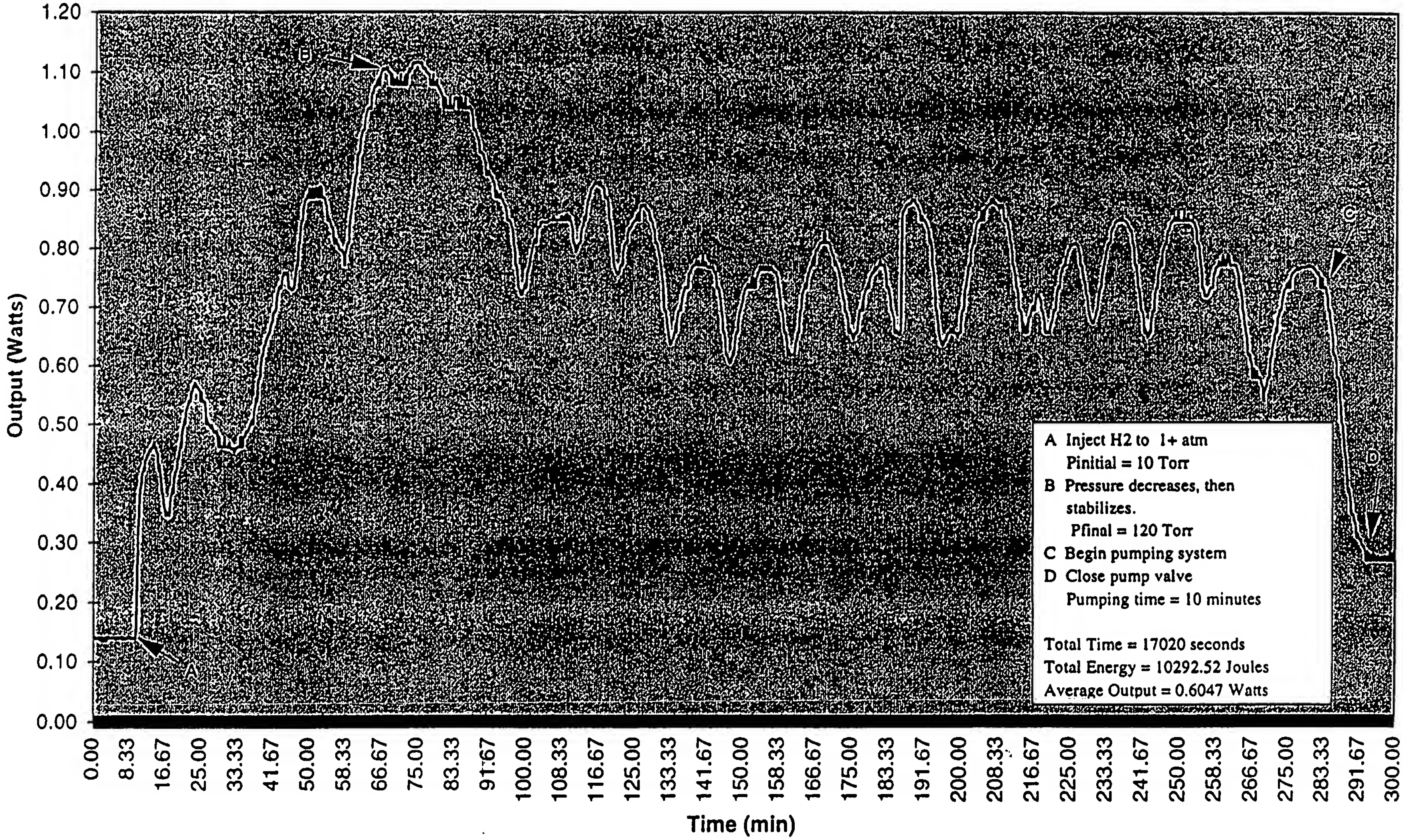


Figure 5

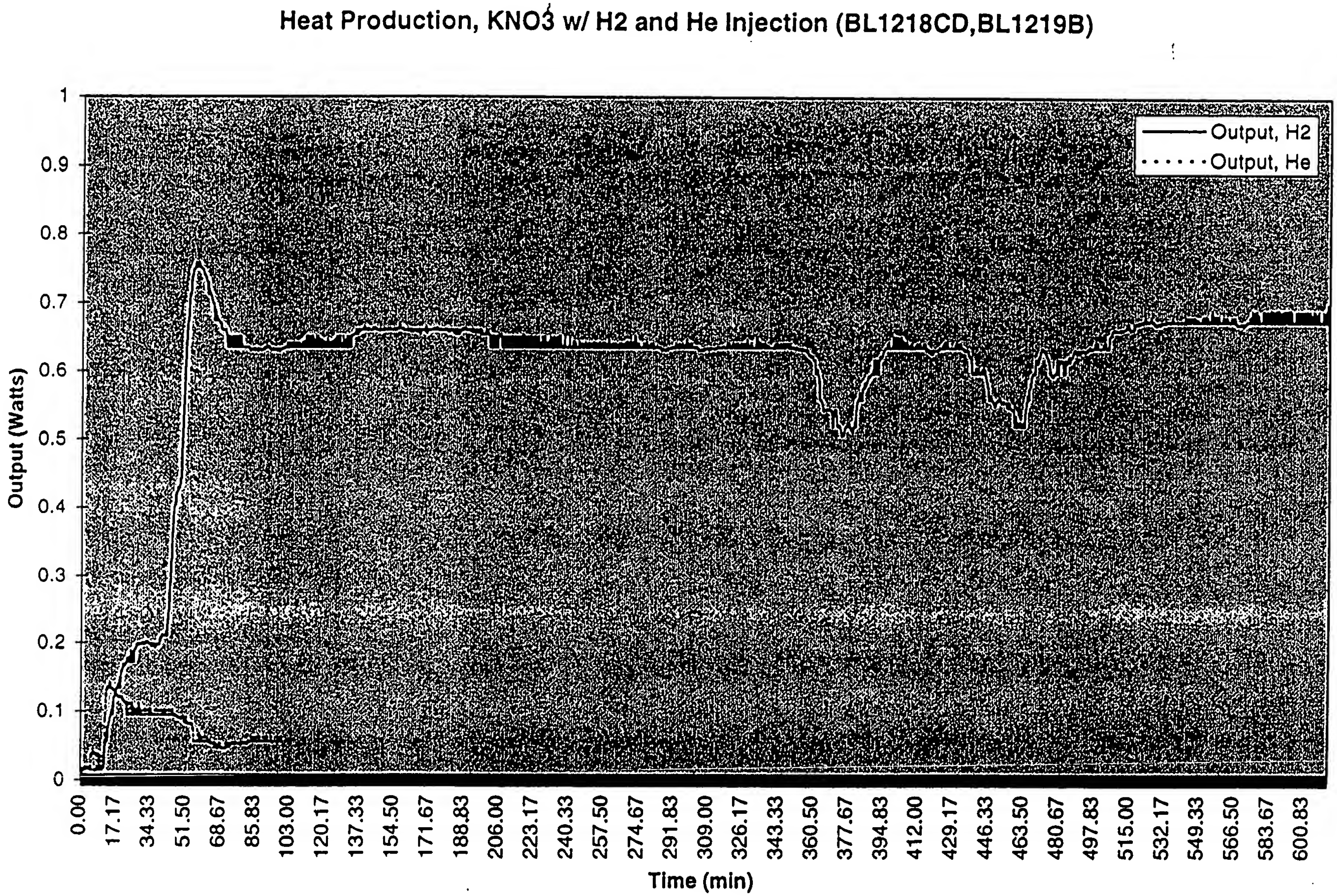

Heat Production, KNO3 w/ H2 and He Injection (BL1218CD,BL1219B)
Output, H2
Output, He
Output (Watts)
Time (min)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.00
17.17
34.33
51.50
68.67
85.83
103.00
120.17
137.33
154.50
171.67
188.83
206.00
223.17
240.33
257.50
274.67
291.83
309.00
326.17
343.33
360.50
377.67
394.83
412.00
429.17
446.33
463.50
480.67
497.83
515.00
532.17
549.33
566.50
583.67
600.83

Figure 6

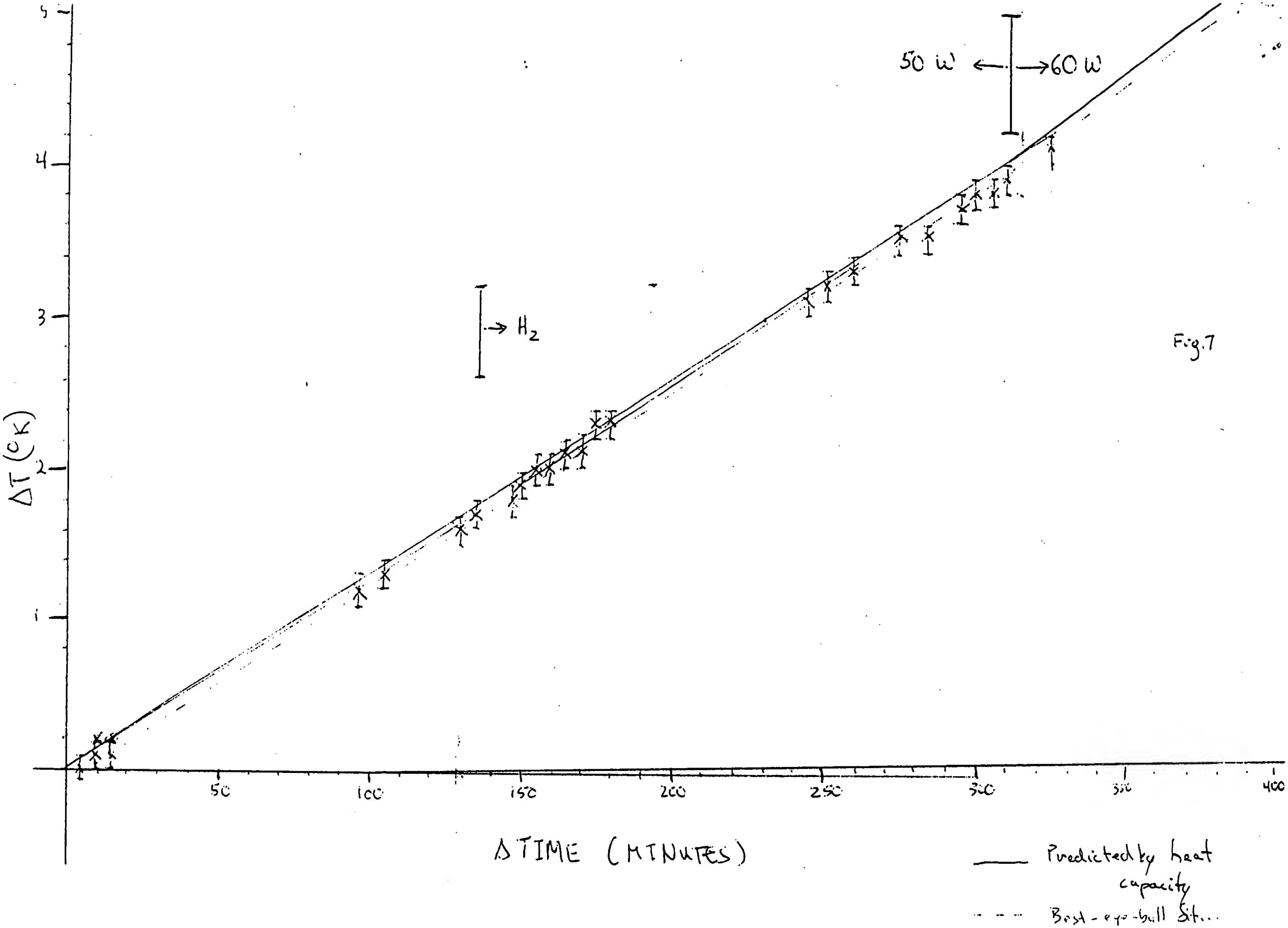


Fig.7

Summary: Rises as predicted by heat capacity with a 10 minute (warm-up) offset.